Safavid Art, Science, and Courtly Education in the Seventeenth Century

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Abstract My paper studies several manuscripts of ʿAbd al-Raḥmān Ṣūfī's *Kitāb al-kawākib al-thābita*, which were produced at the Safavid court, a provincial court at Mashhad or by artists related to either of them. The purpose is to contribute in a small manner to a cultural history of science in a specific context of one of the major post-classical societies. Its main claim is that the Safavid elite paid considerable attention to, and invested substantial resources in, reproducing famous illustrated scientific manuscripts. Content and aesthetic point to Timurid inspirations. In a limited sense, one could speak of a Safavid engagement with translating scientific, medical and geographical texts from Arabic into Persian. The integration of art, science and translation could be described as a specific feature of courtly interest in scholarly knowledge under the Safavids.

Introduction

The Safavid period is usually seen as one with substantial innovation in the arts and a vivacious engagement in philosophical inquiries of the divine, but with little interest as well as sophistication in the mathematical sciences and natural philosophy. There is, however, reason to believe that this view may be inadequate.

In the first decades of Safavid rule, the mutakallim Shams al-Dīn Khafrī (d. c. 1550) studied planetary models in the framework of *ʿilm al-hayʾa* and proposed new solutions for modeling planetary orbs. These models stand in the tradition of Naṣīr al-Dīn Ṭūsī (1201–74) and Qutb al-Dīn Shīrāzī (1236–1311). According to Saliba, they represent the most sophisticated and technically complex achievements known so far [Saliba 1994, 2004].

In the late phase of Safavid rule, astrolabe makers in Isfahan fabricated astrolabes with compasses and sundials that show on one of their plates a Mecca-centered map of the Islamic world.[1] The grid of the map is curved in its horizontal parallels and has been differently interpreted as either representing arcs of ellipses or arcs of circles [King 2004, 843]. A ruler fixed in Mecca links any of the marked places on the map to the religious center of the Islamic world, showing its *qibla*. The mathematical knowledge needed for this map goes back to the ninth or the tenth centuries and was, in all likelihood, developed by scholars working in Baghdad and other cities of Buyid Iran [King 2004, 842].

The more than one hundred years between these two highlights of science and instrumentation in the Safavid Empire are characterized by texts on arithmetic, geometry, algebra, and elementary astronomy that only rarely rise above the level of the introductory. The most often taught, translated, or copied texts in mathematics and astronomy of the period were writings by Bahāʾ al-Dīn ʿĀmilī (1547–1622) such as *Khulāṣat al-ḥisāb* (Essence of Arithmetic) and *Tashrīḥ al-aflāk* (Explanation of

[1] See, for images of these instruments, King, D.A., *Safavid World-Maps Centred on Mecca: A third example and some new insights on their original inspiration* in King [2004].

the Orbs). Practicing astronomers or astrologers commented on or applied Ulugh Beg's (1394–1449) *Zīj-i jadīd* (The New Astronomical Handbook). Hence, while the practice in the mathematical and astronomical disciplines continued, it did so apparently on an elementary level and without outstanding representatives. In contrast to the mathematical sciences, it is not very clear whether Safavid scholars had any interest in problems of natural philosophy.

Reports by travelers from various European countries support the assumption that the rather bleak picture of the sciences in Safavid courtly culture may be flawed or at least incomplete. Although these reports pose their own methodological problems in regard to their description of Safavid activities, knowledge, and beliefs, because their authors created them within the canonical rules of seeing, thinking, representing, arguing, and demonstrating of their own cultures, Safavid manuscripts and paintings leave no doubt that the visitors and their hosts looked at each other with curiosity and attentiveness.[2] The least we can infer from the numerous travel accounts published in the seventeenth and early eighteenth centuries in Europe about the Safavid Empire is that the visitors thought that inhabitants of Safavid Iran were eager to learn and study [Texeira 1902, 251; Richard 1993, vol. 1, 124–5; vol. 2, 127, 270, 304]. They are said to have privileged mathematics, astronomy, astrology, medicine, and philosophy in the writings of ancient Greek scholars such as Euclid, Theodosius, or Ptolemy and in the books of medieval Islamic scholars such as Ibn Sīnā (d. 1036), Naṣīr al-Dīn Ṭūsī, and a number of other scholars whose names the visitors either knew from their own times at university at home such as Aḥmad b. Muḥammad b. Kathir Farghānī (9th c.) or added from sources newly accessible to them through translation [Brenjes 2004, 395–404, 413–414]. Visitors also told of the interests of high-ranking Safavid court officials in new technologies, instruments, and machines brought to Iran by foreign craftsmen and "adventurers" [Richard 1993, 220–232]. Safavid paintings lend credit to such reports in regard to military technology and fortress planning [Vesel 2001, 267].

In this paper, I survey several manuscripts produced at the Safavid court, or in its vicinity, which suggest that we need to find fresh ways of looking at the sciences in the seventeenth century within Safavid culture. A few years ago, Živa Vesel pointed to the importance of illustrated scientific manuscripts produced during the rule of Shāh ʿAbbās I (r. 1588–1629) and Shāh ʿAbbās II (1642–1666) characterizing them as "of exceptional quality" [Vesel 2001, 267]. She suggested studying the history of the sciences in Safavid Iran as an aspect of courtly patronage for the arts. Related views had been formulated earlier from the perspective of art history by Anthony Welch and Barbara Schmitz. Welch emphasized the value that certain Safavid scientific manuscripts have for the study of Safavid art history, while Schmitz raised the opposite point by claiming that a group of Persian scientific manuscripts in The New York Public Library "suggest that a revived interest in classic Arabic and Persian scientific texts began during the reign of Shāh ʿAbbās I" [Schmitz 1992, 61; Welch 1972, 69]. Reflecting the prevalent views on the history of science in post-classical Islamic societies according to which there was no worthwhile scientific activity in these societies, Schmitz speculated cautiously that this apparent revival could have been caused by the growing number of European visitors to Iran and the new scientific knowledge they brought with them [Schmitz 1992, 61].

A second possibility for casting a fresh look on history of science in Safavid Iran is a comparative investigation of different social spaces of education. This approach opposes the verdict of George Maqdisi, and others, that the ancient sciences were excluded from regular teaching at the madrasa, as well as from courtly patronage after 1200. Empirical experience with manuscripts has indicated repeatedly that such views on the sciences in post-classical Islamic societies are misconstrued. But little systematic work has been done so far to create more nuanced pictures about where the sciences were practiced in different Islamic societies after 1200 and by whom, with the exception of Ilkhanid Iran. Hence this paper situates itself as a small contribution to a cultural history of science in Islamic societies that aims to integrate the ancient sciences in their contemporary cultural contexts.

The following survey draws on the results of several art historians which are brought together and

[2] See, for such problems, for instance the report given by the Capuchin Raphaël du Mans in his first rapport written in 1660 where he enumerates authors and disciplines studied and practiced in Isfahan in his time while evaluating their relevance, meaning and 'correctness' according to French beliefs and practices [Richard 1993, vol. 1, 122–131, 133–137, 171–173].

compared with additional manuscripts produced in the late sixteenth and during the seventeenth centuries. It indicates that the Safavid educated elite paid considerable attention to illustrated classical scientific books, commissioned their translations into Persian, and financed their continuous reproduction by calligraphers and painters. Content and illustrations point to Timurid ancestors as sources of inspiration. The variations in detail in regard to the illustrations between the extant manuscripts show that different manuscripts were taken as models for the Safavid reproductions. Hence, while it was undoubtedly good tone to pay for one's own copy of an illustrated version of ʿAbd al-Raḥmān Ṣūfī's (903–986) *Kitāb ḍuwar al-kawākib al-thābita* (Book of the Constellations of the Fixed Stars) or Dioskorides' *Materia medica*, the Safavid elite did not insist on privileging one particular set of representations of the constellations, zodiacal signs, plants, or animals. And while this elite sponsored Persian translations and summaries, it also paid for illustrated copies of scientific texts in Arabic. Such texts were appreciated for their educational and artistic value, if not for their scholarly content. This is documented by a collection ordered by the Great Vizier Khalife Soltan for Shāh ʿAbbās II and copied at the command of the Great Vizier ʿAlījān Muḥammad Khān for Shāh Sulaymān (r. 1666–1694).[3] This collection presents, at its end, the images from Ṣūfī's *Star Catalog*, after bringing together shorter and longer texts on various mathematical sciences and natural philosophy with other disciplines of the rational, traditional, and occult sciences.

In the course of the seventeenth century, a number of manuscripts on astronomy, astrology, medicine, and technology were illustrated with paintings that show a close relation to the styles developed in Isfahan. These manuscripts include an undated copy of Quṭb al-Dīn Shīrāzī's *al-Tuḥfa al-shāhiyya* (The Royal Gift); a group of three Persian copies of ʿAbd al-Raḥmān Ṣūfī's *Star Catalog*, two of which were made between 1630 and 1634 in Mashhad, while one is undated, but placed by Anthony Welch in the middle of the seventeenth century; at least two copies of the Arabic text of this work, one produced possibly around 1630, the other being undated; a new Persian translation of Dioskorides' *Materia medica* ordered by Shāh ʿAbbās I; at least three Persian copies of the *Materia medica* made in 1645 and 1657; and a work about the astrological meanings of each of the 360° degrees of the sky made in Isfahan in 1663 [Schmitz 1992, 60–1, 122–3; Vesel 2001, 293–7; Welch 1972, vol. 2, 69–70].[4] In addition to these copies, there are other illustrated scientific manuscripts produced in seventeenth-century Safavid Iran that may or may not be related to the art of the court.[5] I will first discuss the illustrations of Shīrāzī's *al-Tuḥfa al-shāhiyya*. In the second section, I turn to the three Persian versions of Ṣūfī's *Star Catalog*. In the final section, I will survey the decorative features of the collection made for Shāh ʿAbbās II and Shāh Sulaymān.

An Illustrated Copy of Quṭb al-Dīn Shīrāzī's *al-Tuḥfa al-shāhiyya*

Illustrating a work on planetary theory with drawings by a student of a master painter was a rare enterprise in an Islamic society. In the Safavid period, this is what happened. An unknown patron ordered a copy of one of Quṭb al-Dīn Shīrāzī's two major works on planetary theory to be singled out by adorning it with images taken from the tradition of Ṣūfī's *Star Catalog*. The chosen images represent *Andromeda*, *Andromeda* with *Cetus*, *Auriga*, *Boötes*, and another male figure identified by Vesel as *Hercules* [Vesel 2001, 285].[6] These figurative representations of four constellations are joined to a model of Mercury, a visualization of the relative positions of the poles of various orbs, a parallax diagram,

[3] MS Boston, Arthur M. Sackler Museum, 1984.463.

[4] Welch wrote that the text of the manuscript is Arabic. The text on the two folios published in the Catalog is however Persian. That is why I have included this manuscript in the group of Persian copies of Ṣūfī's *Star Catalog*.

[5] See, for instance, Schmitz [1992, 61].

[6] This figure deviates from the standard representation of the constellation in Arabic manuscripts. It stands upright and holds a small, short object in his left hand. The standard representation shows a kneeling figure with a sickle in one hand.

Figure 1: Reza Abbsi, 1. Photo courtesy of Reza Abbasi Museum.

and a diagram for a specific spherical triangle.[7] The attractive figures are drawn with black ink. Their bodies are portrayed in an elegantly swinging movement. Female and male figures have the same kind of gently rounded faces with almond-shaped eyes, thick brows, short noses, and thin, perhaps slightly smiling, not fully executed lips. They also share, in principle, the same hairstyle. A long lock dangles in front of one ear while the rest of the hair flows freely behind the ears unto the shoulders and down the back. The male figures wear a characteristic Safavid turban and a long shirt under a half-long jacket which is girded by a sash. They hold insignia in their left or right hands, which helps to identify them. *Andromeda* wears a long, pleasantly floating robe that is girded by a sash, similar to that of the male figures. The robe opens from her midriff swinging over long trousers or naked legs. The arms of her robe cover her to her elbows. Her upper body is fully covered. She shows a slightly protruding belly, but no bosom. She wears a diadem on her head and bracelets around her arms. According to Vesel and Richard the figures are drawn in the style of Riẓā–i ʿAbbāsī.[8] This should not come as much of a surprise since Riẓā–i ʿAbbāsī set the norm for many of the court painters from the 1620s [Schmitz 1992, 60, 122]. A comparison with images discussed by Anthony Welch in his paper about the visualization of love in Safavid painting confirms the close relationship in style to Safavid court painters and in particular Riẓā–i ʿAbbāsī. It also shows that the images in Shīrāzī's *Tuḥfa* lack the maturity of the paintings made by this master and the other painters documented by Welch [2001, 302–317, 305–315]. The comparison brings to light that the postures, gestures, and expressions, while following in principle the standard visual codes used for illustrating Ṣūfī's *Star Catalog* for centuries, reverberate clearly with Safavid images of "graceful dandies (who) make smaller claims on heroism, ... embark on no adventures, exterminate no dragons, achieve no notable exploits" [Welch 2001, 301–317]. Such images, produced for albums, were, however, not meant to function within the context of manuscripts as the illustrations of Shīrāzī's text. Welch interpreted them as representations of ideals of love and Sufi worldview. Like the images discussed by Welch, the pictures in Shīrāzī's *Tuḥfa* show idealized, idyllic, beautiful youth [Welch 2001, 303]. But they lack any symbolism that would relate them to Sufi themes. The ease with which the new Safavid painting style was integrated into a manuscript on planetary theory like Shīrāzī's *Tuḥfa* probably results from certain features that characterize the figures in Ṣūfī's *Star Catalog*. The tradition of illustrating this work with individual, gently moving figures clad in playfully swinging dresses may have induced the Safavid painters to treat them in the manner of images destined for an album.

A comparison with the Persian and Arabic manuscripts of Ṣūfī's *Star Catalog*, and of the art historical literature and catalogs that discuss them, brings to light that the illustrations found in Shīrāzī's *Tuḥfa* are closely related to illustrations in MS Geneva, Prince Sadruddin Aga Khan Collection, 9, and a single folio published in 1962 by Ernst Grube, that then belonged to the private collection of Rudolf M. Riefstahl in Toledo, USA. The relationship between these illustrations is particularly strong in the swing of the skirt of *Boötes* in Shīrāzī's *Tuḥfa* and the single folio from the Riefstahl Collection, in one of the three representations of *Andromeda* in Shīrāzī's *Tuḥfa* and the figure of *Andromeda* in the manuscript of the Sadruddin Aga Khan Collection as published by Welch, and of *Cassiopeia* in MS Tehran, Majlis Shūrā 196 as published by Nasr [Grube 1962, pl. 123; Welch 1972, vol. 2, MS 9, f 7v; Nasr 1976, 100, fig. 39]. What I have called here the swing of the skirt is a deviation of the windblown folds of the dresses of Buyid or Seljuq provenance as found in much earlier Arabic manuscripts such as MS Oxford, Bodleian Library, March 144. Wellesz already pointed to the loss of vitality of these folds in some later manuscripts and published an image of *Virgo* from a thirteenth-century Latin codex illustrated in Sicily that shows a schematized rendering of these folds indicating the possible way of variations that led to the swing in the Safavid manuscripts [Wellesz 1964, 85–92, 87, 88, fig. 9, 89, fig. 10]. Grube's suggestion that the figure of *Boötes* from the Riefstahl Collection is quite similar to the drawing of the same figure in MS St. Petersburg, Public Library, Ar. 119 and that "it must be from such a model that the Riefstahl drawing has been copied" cannot be maintained, however.[9] Not only are the illustrations in later Safavid copies of Ṣūfī's *Star Catalog* and in Shīrāzī's *Tuḥfa* much closer to

[7] See, for a description of the diagrams in English, Ragep [1993, vol. 1, 164–174, 194–200, 258–260, 314–316].

[8] Oral information from Vesel. Vesel [2001, 283] dated the manuscript to the sixteenth or seventeenth century and characterized the paintings as done in Isfahani style.

[9] Grube [1962, 138].

the image displayed on the single folio, but also the pictures in the manuscript copied in Naʾin are differently dressed, much more stereotyped, and follow in several cases a different illustrative tradition [Schjellerup 1874, pl. 1–3].

While it is indubitable that the illustrations in the manuscripts discussed here are all very closely related among themselves and, at the same time, distinct from certain of the Arabic copies produced in seventeenth-century Safavid Iran, they differ nonetheless in many of their details and thus were apparently made by different painters who used different models. Since most of them do not have inscriptions, the identification of their painters is fraught with difficulties, as the diverging opinions among art historians show. Grube dated the image of *Boötes* towards the end of the seventeenth century without any specific argument, while linking its style to the early seventeenth century [Grube 1962, 128]. Welch dated the manuscript of the Sadruddin Collection to the middle of the seventeenth century by ascribing its style to a painter strongly influenced by Muḥammad Yūsuf. He considered the artist who drew the sixty-five pen and ink illustrations as "very competent and sometimes gifted" and "obviously trained in an Isfahan atelier, or one closely related to it " [Welch 1972, vol. 2, 70]. In addition, there are persuasive stylistic connections between some of the illustrations in the copy of the Persian translation of Ṣūfī's *Star Catalog* extant in The New York Public Library as Spencer, Pers. 6 (called from now on: Spencer manuscript) and the single image of *Boötes* in the Riefstahl Collection. While *Boötes*' dress and the object he holds in one hand are closely related to the dress and object of *Boötes* in Shīrāzī's *Tuḥfa*, the face of the Riefstahl *Boötes* is very similar to the face of the unusual representation of *Cetus* in the Spencer manuscript [Schmitz 1992, fig. 127]. This then links the images in the Safavid copy of Shīrāzī's *Tuḥfa* to specific copies of Ṣūfī's *Star Catalog* and their painters.

Illustrated Copies of a New Safavid Translation of Ṣūfī's Star Catalog into Persian

In 1630/31, a new Persian translation of Ṣūfī's *Star Catalog* was made at the command of ʿAbū l-Fatḥ Manūchihr Khān (d. 1636). Manūchihr was a son of the general of Georgian origin Qarajaghāy Khān (d. 1623), who served Shāh ʿAbbās I. Like his father, he was a general and governor of Mashhad. He served under ʿAbbās I and Ṣafī (r. 1629-1642) [Schmitz 1992, 55, 123]. The translator of the text was Ḥasan b. Saʿd Qāʾinī, an astrologer at Manūchihr's court. The name of the scribe of the Spencer manuscript is given repeatedly as Muḥammad Bāqir al-Ḥāfiẓ whom Schmitz tentatively identified with the calligrapher Muḥammad Bāqir b. Mullā Maḥmūd Gīlānī [Schmitz 1992, 123]. In a preface written by the translator, the paintings of the Spencer manuscript, produced between 1630 and 1633, are attributed to Malik Ḥusayn Iṣfahānī. Schmitz argues that it was rather his son, Muḥammad ʿAlī, who painted most, if not all of the images [Schmitz 1992, 123–124]. She allows, however, that the second copy of this work produced in 1633–34 and extant in Cairo may include one painting executed by the father, that of *Virgo*.[10] She also suggests that possibly more than these two painters were involved in the execution of the extant manuscripts of Qāʾinī's translation [Schmitz 1992, 123]. In contrast, Farhad claimed that nothing in the images of the Spencer manuscript contradicted their ascription to the father [Babaie, Babayan, Baghdiantz-McCabe and Farhad 2004, 128]. While this is certainly true, the pictorial basis for making claims of a general character seems to be rather small. The only point of the divergent evaluations of Schmitz and Farhad, which I believe can be settled at the moment in a satisfactory manner, is the relationship between the images of *Virgo* in the two manuscripts. A comparison of these two images indicates that *Virgo* in the Cairo manuscript is a slightly unfinished and less skilled version of *Virgo* in the Spencer manuscript. The colors chosen for *Virgo* in the Spencer manuscript are finely harmonized with each other. In the Cairo manuscript, however, the color of the over-coat contrasts with the color range chosen for the chemise and trousers. The wheat ears in *Virgo*'s left hand in the Cairo manuscript show a coarser form, less in agreement with the ears' natural appearance than in the Spencer manuscript. Certain parts of *Virgo*'s body in the Cairo manuscript, such as her right ear or her chin, are less proportionate and worked out. Even *Virgo*'s wings in the Cairo manuscript taken by

[10] MS Cairo, Dār al-Kutub, MMF9; King [1986, pl. III]; Edwards and Signell [1982, 13]; Schmitz [1992, 123].

Schmitz as the indicator for Malik Ḥusayn's authorship of the image fall short of the elegance and completion they show in the Spencer manuscript [Schmitz 1992, 123; Edwards and Signell 1982, 13]. Thus, I propose considering the images of *Virgo* in the Spencer manuscript as the work of Malik Ḥusayn and those in the Cairo manuscript as the work of another, possibly junior painter. The miniatures of a third manuscript, MS Tehran, Malik Library, 6037, considered by Schmitz "stylistically similar" to those in the Spencer and the Cairo manuscripts are the work of another painter or perhaps group of painters [Schmitz 1992, 123].[11] The manuscript is dated 1598, which was unknown to Schmitz.[12] Hence, it is much earlier than the artistic undertakings related to Qāʾinī's Persian translation.

The text of Qāʾinī's Persian translation and its illustrations in the Spencer and the Cairo manuscripts show a number of interesting features, as Farhad has already pointed out. Her observations on the art historical novelties of these illustrations are of particular importance. She stressed the new pictorial style in a scientific manuscript, the unusually large format of the illustrations, and their refined drawing and painting techniques [Babaie, Babayan, Baghdiantz-McCabe and Farhad 2004, 128]. Some of her ideas about the scholarly relevance of the translation are less persuasive, since she took claims made by the translator at face value. In his preface, Qāʾinī reports that he discovered deviations between the values in the Arabic text of the *Star Catalog* and what he could observe in the heavens in his own time. That is why he decided to correct the Arabic text following values found in Ṭūsī's *Zīj-i Īlkhānī* and Ulugh Beg's *Zīj-i jadīd*.[13] For Qāʾinī, the authority for settling scientific disputes rested obviously with acknowledged authors, not with nature or himself in his capacity as an observer. A comparison with other manuscripts of Ṣūfī's *Star Catalog* suggests, however, to take any such claim of observational acuity and revisionist project with some caution. Such claims did not necessarily reflect scientific practices and aims. They highlight rather other matters of cultural relevance. Such an interpretation is seconded by the observation that the rhetoric of cosmic change, scientific dispute, and necessary corrections was an important element of representation that already characterized ʿAbd al-Raḥmān Ṣūfī's own preface to his work. Furthermore, after having surveyed the copy of Ṣūfī's *Star Catalog* extant in the Bibliothèque nationale in Paris, which was produced for Ulugh Beg, Blochet stated that the coordinates in this manuscript were taken from the *Ilkhanid Tables* of Naṣīr al-Dīn Ṭūsī.[14] Since Ulugh Beg and his astronomers worked themselves on new astronomical tables, they could have easily replaced the outdated values by their own observations. Their choice of the *Ilkhanid Tables* may have been inspired not by science alone, but by the well-known Timurid cultural politics of representing themselves as legitimate heirs of the Mongols. Such an interpretation gains additional plausibility by the fact that Ulugh Beg's copy of Ṣūfī's *Star Catalog* derived from a copy owned by Naṣīr al-Dīn Ṭūsī [Richard 1997, 78]. Since the Safavids on their part represented themselves as legitimate political and cultural heirs of the Timurids, Qāʾinī's choice of the tables of Naṣīr al-Dīn Ṭūsī and Ulugh Beg for making up for nature's changes may reflect this imitation as much as it represents his and his patron's interests in the heavens and their accurate portrayal. The possibility of using such scientific works effectively for political ends increased their attractiveness for rulers and courtiers as did their artistic appearance. Taking up one aspect of Farhad's arguments about the meaning of such a major project executed by a ghulām, it may perhaps even be considered that the scientific content of the work provided a less contentious entrance into patronage of the arts and knowledge and the claims to status and position among the elites going with such an act than the choice of a major work of literature due to the latter's long use by ruling families and members of the military aristocracy for expressing their claims to power and interpretation of the world [Babaie, Babayan, Baghdiantz-McCabe and Farhad 2004, 129, 134, 137].

Art historians have long recognized that the copies of Qāʾinī's Persian translation of Ṣūfī's *Star Catalog* and their paintings were situated within the life of the Safavid courtly elite. In 1962, Grube

[11] I have not seen the manuscript itself, but only two more miniatures than the ones available to Schmitz. I thank Živa Vesel for her help in this and other aspects relevant to my discussion in this paper. See Vesel, Tourkin and Porter [forthcoming, ill. 79–80]. Farhad repeated Schmitz's position and even suggested that the manuscript was of a slightly later date than the Spencer and the Cairo manuscripts [Babaie, Babayan, Baghdiantz-McCabe and Farhad 2004, 130].

[12] I owe this information to Živa Vesel.

[13] See, for instance, MSS Paris, BnF, Supplément Persan 1551 (16th c.), Arabe 4670 (17th c.).

[14] MS Paris, BnF, Arabe 5036; Blochet [1912, 48–49].

Figure 2: Reza Abbsi, 2. Photo courtesy of Reza Abbasi Museum.

Figure 3: BnF Arabe 4670, 5036. Photo courtesy of Bibliothèque nationale, France.

wrote that the paintings of the New York manuscript "are the largest and most magnificent of the Isfahan school known, disregarding the wall-paintings of the ʿAlī Qāpū and the Chahīl Sūtūn in Isfahan. They are unquestionably not all by the same hand, but they are all of first quality. The entire aspect of the magnificently written and produced volume would suggest an origin in the court school of Isfahan. Riẓā–i Abbāsī was then still alive and it must have been under this immediate direction that the paintings were executed" [Grube 1962, 129–130]. Grube's view that the paintings in the Spencer manuscript belong to the most magnificent specimen of the Safavid period has been seconded by Anthony Welch who considered them as belonging to the most beautiful illustrations found in scientific manuscripts [Welch 1973, 76–77, 82]. Farhad proposed a new perspective from which to evaluate these images. She declines see them as an extension of, or competition with, the painting style en vogue at court in Isfahan. She considers it more appropriate to interpret the activities in Mashhad as creating an independent space for the arts of the book destined to reinforce the ghulāms' claims to a Persian identity [Babaie, Babayan, Baghdiantz-McCabe and Farhad 2004, 134–137].

Two miniatures in particular have drawn the attention of art historians – the painting of *Sagittarius* and the painting of a camel. The former is important since it seems to portray Manūchihr, an assumption based on specific features of the turban that *Sagittarius* wears [Schmitz 1992, 123]. This interpretation wins credit due to the individualized features of *Sagittarius*' face. Farhad took this inscription of the governor's face into the pictorial cycle as a repetition of what she calls "a well-established Persian practice" of emphasizing the fact of patronage [Babaie, Babayan, Baghdiantz-McCabe and Farhad 2004, 129]. It happened, however, very seldomly that a scientific manuscript was appropriated to such an end. The only other scientific manuscript known to me that shows in one of its illustrations features of a patron is the copy of the *Star Catalog* produced for Ulugh Beg [Richard 1997, 78]. This parallelism is probably insufficient for claiming a conscious analogy between the Timurid prince and the Georgian convert. Manūchihr seems rather to have aimed to invoke a parallel between himself and ʿAbbās I, as Farhad suggests based on Jalāl al-Dīn Munajjim's history of ʿAbbās I. The transformation of Isfahan into the shah's new capital apparently was linked with *Sagittarius* [Babaie, Babayan, Baghdiantz-McCabe and Farhad 2004, 129]. Farhad also considers the possibility that the governor's birthday fell in the same sign [Babaie, Babayan, Baghdiantz-McCabe and Farhad 2004, 129]. Such a multiplicity of meaning can only have increased the sign's attraction to the governor.

The image of the camel is an addition to the constellations usually portrayed in Ṣūfī's *Star Catalog*. It shows a naturalistic rendering of a seated camel. On its back lies a sumptuous saddle cloth. A few stars cover its body, but no names are added for identifying them. This additional visualization of a group of stars is backed by Ṣūfī's text as Schmitz has pointed out since Ṣūfī emphasized that certain stars in the constellation of *Cassiopeia* look like the hump of an Arabic camel, while others resemble its neck [Schmitz 1992, 125]. The saddle cloth of the camel is closely related to such representations on two Safavid paintings extant in the Sadruddin Collection (IR.M.31 and IR.M.36). IR.M.31 shows a single camel dated by Anthony Welch and Stuart C. Welch to the late sixteenth century. Its saddle cloth contains the same type of floral and ornamental motifs used by the painter of the camel in the Spencer manuscript [Welch and Welch 1982, 178]. IR.M.36 depicts two fighting camels the right of which carries a saddle cloth with some motifs found in the Spencer manuscript. Welch and Welch [1982, 184] ascribe this miniature to Isfahan and date it to 1630, i.e. close to the production of the Spencer manuscript. Neither of the two miniatures bears an inscription, however, and Welch and Welch did not try to ascribe them to any particular Safavid artist. The painting of the camel in the Spencer manuscript is, however, not the first effort to translate the textual comments into visual experience. In an illustration of *Cassiopeia* in a twelfth-century Arabic manuscript, a camel is shown behind the female figure.[15] In a sixteenth-century Arabic manuscript ascribed to Egypt, *Cassiopeia* sitting on her throne holds the leash of a lying camel with a saddle cloth and a saddle in her right hand.[16] Hence, the inclusion of a camel in the Spencer manuscript may not reflect artistic innovation on the side of the Safavid painter, but the model of the *Star Catalog* he used.

Two other illustrations in the Spencer manuscript, *Cetus* and *Andromeda*, show further remarkable

[15] MS Oxford, Bodleian Library, Hunt. 212; Wellesz [1964, 89–90].

[16] MS Paris, BnF, Arabe 2490.

Figure 4: Spencer Pers. 6, Auriga. Photo courtesy of the New York Public Library.

alterations of the two major palettes of visual codes set, according to Wellesz, by early manuscripts of the work [Wellesz 1964, 86–89].[17] *Cetus*, the monster sent by Neptune to devour Andromeda chained to a rock and slain by Perseus with the cut off head of Medusa, is here represented as a young man with hands and arms too big for his body and interpreted by Schmitz as a giant [Schmitz 1992, 127 fig. 127]. The form of his face comes very close to the face of *Boötes* in the Riefstahl Collection, while Schmitz pointed to the similarities of his skullcap with that of a groom in a miniature held by the Arthur M. Sackler Museum, Harvard University and signed by Muḥammad ʿAlī b. Malik Ḥusayn [Schmitz 1992, 123]. *Andromeda* is shown from the back and only clad in a diaphanous, red colored, striped skirt. In one image, *Cetus*, now shown in his traditional iconography as a sea monster, has swum under the skirt and bites her in one of her thighs. In the other image, an additional, bigger fish covers *Andromeda*'s back trying to get under her skirt from above. In both images, *Andromeda* holds a torch and is chained by a long chain attached to her wrists. This motif is quite interesting since it differs from what is known about a chained *Andromeda* in Arabic manuscripts. According to Wellesz, "it is only her feet which are fettered, an indication that the connexion with the original myth no longer exists" [Wellesz 1964, 89]. It may be that the cultural background of Manūchihr's family explains this return to ancient Greek mythology in *Andromeda*'s visualization.

In contrast to many other extant manuscripts of Ṣūfī's *Star Catalog*, the paintings of a number of the constellations and zodiacal signs in the Spencer manuscript are fully colored. The painters used a comparatively broad scale of colors ranging from paler (yellow, orange, purple, green, grey) to darker kinds (red, mauve, blue, green, brown, black) [Schmitz 1992, 124–127]. The figures show volume and compactness, a result of the coloring and the application of new painting techniques as Farhad has argued [Babaie, Babayan, Baghdiantz-McCabe and Farhad 2004, 128]. They also show details of what a particular painter privileged when painting a woman or a man in color. *Virgo*, for instance, is not only fully dressed in a robe, underskirt, and trousers and wears two jeweled necklaces and earrings as traditionally prescribed in the visual standards of the *Star Catalog*. She also has fine, long, black hairs arranged carefully, a full bosom, a slightly rounded belly, a full face with a visible double chin, a gracious posture, and red colored finger and toe nails matching her red lips. The clothes, headgears, hairstyles, and faces of the various figures, while documenting the shared visual practices, differ clearly in their details when compared to Shīrāzī's *Tuḥfa*. The single lock before an ear is missing in some of the male figures, while taking a different form in other male figures. The noses, fingers, and toes are substantially longer and drawn, as other parts too, with visibly more care and capability. In addition, *Hercules* wears an Indian turban not found in Shīrāzī's *Tuḥfa*, differs in his posture, and holds no object in his hand [Schmitz 1992, 124].

Another sumptuously illustrated Safavid copy of Ṣūfī's *Star Catalog* is preserved in the Majlis Library in Tehran which has been dated by Vesel to around 1630 [Vesel 2001, 296]. It contains an Arabic text. Its images, while done by a different painter than those in the copies of Qāʾinī's Persian translation, show a clear relationship to those in the Spencer manuscript. *Virgo*, for instance, is largely identical with *Virgo* in the Spencer manuscript, although she differs in a number of smaller, and a few substantial, details, such as the fact that her free hand is placed before her body, not pointing to the side away from it. Since this type of gesture can be found in earlier manuscripts too, the painter(s) of this manuscript apparently worked from a different model than those in Mashhad [Wellesz 1964, 88, fig. 9; 89, fig. 10]. All in all, *Virgo* in this Arabic copy of the *Star Catalog* is executed with much less finesse and care. As a result, she is less lively and more stereotyped. The color palette and the background may suggest an Indian inspiration of a Safavid painter or perhaps even an Indian, possibly Deccani, origin of the picture the painter of which reproduced a Safavid model.[18]

The quantity and quality of illustrated copies of Ṣūfī's *Star Catalog* in Arabic and Persian produced during the seventeenth century in Iran, and perhaps outside its borders, in styles reminiscent of Riẓā–i ʿAbbāsī should encourage us to question the prevalent mode of thinking about the sciences in Safavid Iran. Safavid patrons obviously invested considerable sums, if not fortunes, into the production of these

[17] For images from other manuscripts compare Upton [1933, 179–197, 184, 188, 190–191, 193] and Caiozzo [1999, 11–51,41–42].

[18] For other images from this manuscript see Vesel, Tourkin and Porter [forthcoming, ill. 86–93].

Figure 5: Spencer Pers. 6, Virgo. Photo courtesy of the New York Public Library.

manuscripts. Painters considered the text and its illustrations not beneath their skills and capabilities. They invested in adapting the models available to them to contemporary tastes and styles. Some of them treated the painting of star constellations with the same professional standard they applied to other themes and turned them into art objects of high quality. The knowledge of the stars and their distribution in the night sky was apparently valued highly when it came in the format of a lavishly illustrated book. Courtly education, art, pleasure, and political rhetoric achieved a new symbiosis in these Safavid scientific manuscripts.

On the Images of Ṣūfī's *Star Catalog* in a Collection Composed for Shāh ʿAbbās II and Copied for Shāh Sulaymān

The collection preserved at the Arthur M. Sackler Museum, Harvard University is a rare document of courtly efforts to ensure royal education in a tasteful setting. In contrast to the Timurid collections of literature, science, and art, this collection was not produced to show off the prince's encyclopedic knowledge and appreciation of refined, artful style. The collection rather was ordered by two successive great viziers for their successive masters. A broad array of fields of knowledge from religion to science has been brought together in more than one hundred, mostly short pieces of texts in Arabic and Persian. Many of them are extracts from famous, often much older writings such as Euclid's *Elements*, Ibn Sīnā's comments on philosophical issues such as matter and form, Naṣīr al-Dīn Ṭūsī's commentary on Fakhr al-Dīn Rāzī's (1149–1210) commentary on Ibn Sīnā's *Ishārāt wa-tanbihāt*, or Qutb al-Dīn Shīrāzī's commentary on the theoretical part of Ibn Sīnā's medical encyclopedia. Other texts summarize briefly components of a particular domain of knowledge such as algebra, surveying, arithmetic, number theory, music, astrology, numerology, optics, geography, natural philosophy, metaphysics, logic, Shiʾi law, ḥadīth, or ʿirfān. In addition to these short texts, which fill the margins of the pages, the center of the pages are covered by either two longer texts of different lengths and written in different sizes running in form of parallel horizontal rows or by texts running in form of one or more parallel vertical columns of subsequent series of lines posited in an acute angle. These longer texts include the dedication and titles of the Safavid rulers, writings by the two great viziers on elementary issues of arithmetic and mathematical riddles, debates on various subject matters such as unity and multiplicity, the supra- and sublunar world, the rules of grammar or poetic compositions, or the structure of the universe. Occasionally, other formats structure a page. Examples are a circular table in the center of the page surrounded by texts written in six different directions, or pages divided in halves filled with lines that begin in opposite corners and run in opposite directions. Tables destined for learning numbers, the names of God, the four- or five-fold structures of the natural world, the distances between various towns of Iran, geographical coordinates, astrological categories, astronomical divisions, and the names of the months are interspersed between the texts either filling an entire page or parts of it in various sizes. Diagrams are placed between the lines of the first central text or are imbedded between the pieces of text in the margins. They show a hand giving the numerical values of different parts of the fingers, a quote from Ptolemy's *Astrology*, a *qibla numa* for Tabriz, a plan of the Kaʿba, an allusion to Jerusalem, geometrical figures from Euclid's *Elements*, the circular orbs of the components of the universe, a planetary model, eclipses, grammatical units arranged in circles, a model of the eyes, and numerological arrangements. Further visual forms of presenting knowledge are a world map taken from a version of Zakariyāʾ Qazwīnī's (1203–1283) *ʿAjāʾib al-makhlūqāt* (The Wonders of the Created (Things)) and the star constellations and zodiacal signs from Ṣūfī's *Star Catalog*.

In addition to the complex arrangements of the textual units, several forms of artistic decoration have been applied. Different kinds of colored illuminations emphasize the titles of short pieces of text, function as separators, or replace the central texts. Several types of calligraphy and the use of ten colors for writing text, tables, and diagrams, often applying four, five, or six of these colors on one folio, are a further level of illumination that contributes to rendering the manuscript into a piece of art. Floral and ornamental bands and stripes provide yet another layer of decoration.

The last four folios of the manuscript are devoted to the 48 constellations from Ṣūfī's *Star Catalog*. The choice of the representations follows no clear scheme. Some of them represent Ṣūfī's category of the figure according to "what is seen at the heavens," while others reflect his other category of "what is seen on the globe." The images do not follow strictly the order of the illustrations in the *Star Catalog*, but start with the zodiacal signs, which in themselves proceed according to Ṣūfī's order. Then the star constellations begin, the first being *Ursa Minor* followed by *Ursa Maior* and *Draco*. With one exception, the exchange between *Pegasus* and *Equuleus*, the order followed in the Sackler manuscript agrees with the standard version of the *Star Catalog*. There are a few peculiarities in the naming of the constellations in the Sackler manuscript. *Andromeda with the Northern Fish* is called *al-Rishāʾ* (the Rope). *Andromeda* does not carry her Arabic name, but a transliteration of the Greek form. *Auriga*'s Arabic name is reduced to *al-ʿInān* (the rein). And the name of *Equus Maior* is missing altogether.

The visual representation of the figures is much simpler than those painted in styles related to the Isfahan school. The artist used black ink, red, and gold. The figures are slim and in many cases modestly dressed. Most of the figures show crowns, hats, and dresses that can be found in miniatures painted long before the late seventeenth century. This applies in particular to the short skirts of *Boötes*, *Hercules*, and *Cassiopeia* and to the headgears of *Boötes*, *Cassiopeia*, *Andromeda*, and *al-Rishāʾ*.[19] Only *Auriga*'s and *Orion*'s turbans and some of the sashes resemble Safavid styles as seen in the previously discussed copies of the *Star Catalog*. Certain images also show some resemblance to representations of the constellations in copies of Qazwīnī's *ʿAjāʾib al-makhlūqāt*. This applies for instance to the headgear of *Sagittarius* and the cross in *Centaurus*' hand. The slimness of the figures as a whole, however, agrees with trends in Safavid painting in the second half of the seventeenth century. It also fits the overall aesthetic appearance of the collection with its fine ornamental and floral illuminations, neatly drawn diagrams, and use of thin qalams for writing all but the main text in the center of a folio. This renunciation of any explicit pictorial reference to the Safavid court and the style it patronized in the more sumptuous paintings of the period in a manuscript explicitly produced for two Safavid rulers by two Safavid top ranking administrators raises interesting questions as to the meaning and function of the star constellations within the overall plan of the collection. In the current state of investigation, such questions cannot be answered in a well-founded and satisfying manner. The only feature that can be emphasized is the almost complete isolation of the figures from their usual scientific context. Neither do they show any of the stars they are meant to represent. Nor is there any table giving the stars' coordinates. All that remains from the *Star Catalog*, in addition to the figures, are their Arabic and Arabicised Greek names. In combination with some other parts of the collection this feature may emphasize a didactic and mnemonic purpose, and hence underscores the possible educational meaning of the entire collection.

Some Reflections in Place of Conclusions

This selective survey of some of the illustrated scientific manuscripts produced in the seventeenth century in the environment of the Safavid court and in relationship to the art styles developed in Isfahan points to the need to revisit the history of the sciences in this period and space. The material basis for such a revision is much broader than outlined in this paper. A systematic collection of illuminated, as well as dedicated, scientific manuscripts and an analysis of their relationships to the courts and other social and cultural spaces in Safavid Iran is a necessary preliminary step. It has the potential to open our eyes to new questions about the attraction that scientific texts exercised on Safavid patrons, readers, artists, scholars, and collectors, the impact such knowledge had in various circles, the degree to which such texts were available for carrying messages others than their scientific content and for opening up to new forms of layout and design, or the processes of standardization and differentiation to which such illuminated manuscripts can bear witness.

[19] Compare, for instance, Lentz and Lowry [1989, 146–148, 171, 175, 186–187, 194].

References

Manuscript Sources

Boston, Arthur M. Sackler Museum, 1984.463.
Cairo, Dār al-Kutub, MMF9.
New York, The New York Public Library, Spencer, Pers. 6.
Oxford, Bodleian Library, Hunt. 212.
Paris, BnF, Arabe 4670.
Paris, BnF, Arabe 5036.
Paris, BnF, Supplément Persan 1551.
Tehran, Majlis Shūrā, 197.
Tehran, Malik Library, 6037.

Modern Scholarship

Babaie, S., Babayan, K., Baghdiantz-McCabe, I., Farhad, M., 2004. Slaves to the Shah. New Elites of Safavid Iran. I.B. Tauris, London and New York.

Blochet, E., Catalog des manuscrits de la Bibliothèque Nationale. Tome Deuxième. Imprimerie Nationale, Paris.

Brentjes, S., Early Modern Western European travellers in the Middle East and their reports about the sciences. In: Pourjavady, N., Vesel, Ž. (eds.), Sciences, techniques et instruments dans le monde iranien (X^{e}-XIX^{e} siècle). Tehran, Presses Universitaires d'Iran, Institut Français de Recherche en Iran, pp. 379–420.

Caiozzo, A., Le ciel de l'astronome, le ciel de l'astrologue et celui du sorcier, trios conceptions des cieux dans les manuscrits enluminés de l'orient médiéval. In: Gyselen, R. (ed.), La Science des cieux. Sages, mages, astrologues. Peeters, Paris, pp. 11–51.

Fogg Art Museum, 1973. Fogg Art Museum, Harvard University, Cambridge, Mass. 19 January-24 February, 1974. Fogg Art Museum, New York.

Grube, E., 1962. Muslim Paintings from the XIII to the XIX Century from Collections in the United States and Canada. Catalog of the Exhibition. Neri Pizza Editore, Venezia.

King, D.A., 1986. A Survey of the Scientific Manuscripts in the Egyptian National Library. American Research Center in Egypt, Cairo.

——— 2004. Safavid world-maps centred on Mecca: A third example and some new insights on their original inspiration. In: King, D.A., In Synchrony with the Heavens: Studies in Astronomical Timekeeping and Instrumentation in Islamic Civilization, 2 vols. Brill, Leiden.

Lentz, T.W., Lowry, G.D., 1989, Timur and the Princely Vision. Persian Art and Culture in the Fifteenth Century. Los Angeles County Museum of Art, Arthur M. Sackler Gallery, Los Angeles.

Nasr, S.H., 1976. Islamic Science: An Illustrated Study. World of Islam Festival Publishing Co. Ltd, London.

Edwards, H., Signell, K., 1982. Patterns and Precision. The Arts and Sciences of Islam. National Committee to Honor the Fourteenth Centennial of Islam, Washington, D.C.

Ragep, F.J., 1993. Naṣīr al-Dīn Ṭūsī' *Memoir on Astronomy* (al-Tahdkira fī ʿilm al-hay'a), 2 vols. Springer-Verlag, New York.

Richard, F., 1993. Raphaël du Mans missionaire en Perse au XVII^{e} siècle, 2 vols. Editions L'Harmattan, Paris.

——— 1997. Splendeurs persanes: Manuscrits du XII^{e} au XVII^{e} siècle. Bibliothèque nationale de France, Paris.

Saliba, G., 1994. A sixteenth-century Arabic critique of Ptolemaic astronomy: The work of Shams al Dīn al-Khafrī. Journal for the History of Astronomy 25, 15–38.

——— 2004. Šams al-Dīn al-Ḥafrī's (D. 1550) Last work on theoretical astronomy. In: Pourjavady, N., Vesel, Ž. (eds.), Sciences, techniques et instruments dans le monde iranien (X^{e}–XIX^{e} siècle). Presses Universitaires d'Iran / Institut Français de Recherche en Iran, Tehran, pp. 55–66.

Schjellerup, H.C.F.C., 1874. Descriptions des étoiles fixes composée au milieu du dixième siècle de notre ère par l'astronome persan Abd-al-Rahman Al-Sûfi. L'Académie Impériale des sciences, St.-Pétersbourg.

Schmitz, B., 1992, Islamic Manuscripts in The New York Public Library. With contributions by Latif Khayyat, Svat Soucek, Massoud Pourfarrokh. Oxford University Press and The New York Public Library, New York and Oxford.

Teixeira, P., The Travels of Pedro Teixeira, Sinclair, W.F., Ferguson, D. (eds.), The Hakluyt Society, London.

Upton, J.M., 1933. A manuscript of "The Book of the Fixed Stars" by ʿAbd ar-Raḥmān aṣ-Ṣūfī. The Metropolitan Museum of Art Studies 4, 179–197.

Vesel, Ž., 2001. Science and scientific instruments. In: Pourjavady, N., Parham, M. (eds.),The Splendour of Iran. vol. 3: Islamic Period. Applied and Decorative Arts. The Cultural Continuum, Booth-Clibborn Editions, London, pp. 260–311.

Vesel, Ž., Tourkin, S., Porter, Y., with Pourjavady, N., Richard, F. (eds.), Forthcoming. Images of Islamic Science. Illustrated Manuscripts from the Iranian World. UNESCO, Tehran.

Welch, A., 1972. Collection of Islamic Art. Prince Sadruddin Aga Khan. 4 vols. Chateau de Bellerive, Geneva.

——— 1973. Shah ʿAbbas and the Arts of Isfahan. An Exhibition at Asia House Gallery, New York, 11 October-2 December 1973. The Asia Society, New York.

——— 2001. Worldly and otherworldy love in Safavi painting. In: Hillenbrand, R., (ed.), Persian Painting. From the Mongols to the Qajars. I.B. Tauris & Co. Ltd., London, pp. 302–317.

Welch, A., Welch, S.C., 1982. Arts of the Islamic Book. Cornell University Press, Ithaca.

Wellesz, E., 1964. Islamic astronomical imagery. Classical and Bedouin tradition. Oriental Art 10, 85–92.